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(54) SOFT-MAGNETIC SINTERED ALLOY REDUCED IN COERCIVE FORCE AND RESIDUAL MAGNETIC FLUX DENSITY AND ITS PRODUCTION AND CONVERGENCE YOKE USING THE SAME ALLOY

(57)Abstract:
PURPOSE: To produce a soft-magnetic sintered alloy reduced in coercive force and residual magnetic flux density by forming the oxide of a metal, having affinity for oxygen higher than that of iron, on the surface of sintered grains of a soft-magnetic sintered alloy containing essentially iron, Ni, and copper.
CONSTITUTION: A powder of an alloy, composed essentially of iron and/or Ni and 0-30wt.% copper and a metal (Al, Ti, etc.) having affinity for oxygen higher than that of iron, is heated in an oxidizing atmosphere, e.g. in gaseous hydrogen containing water vapor, at about 600-1000°C for about 1-5hr. By this procedure, the metal having affinity for oxygen higher than that of iron moves toward the surface of the alloy powder, reacts with oxygen, and forms oxide. A powder lubricant is added, if necessary, to the alloy powder, and the resulting powder mixture is about press-compacted at about 500-700MPa and sintered in hydrogen at about 800-1100°C for about 0.5-3hr. By this method, the soft-magnetic sintered alloy, having frequency characteristic of high magnetic permeability even in the case of high-frequency waves, reduced in coercive force and residual magnetic flux density, and suitable for convergence yoke, can be obtained.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]Both this inventions relate to a soft magnetism sintered alloy soft magnetism sintered alloy with both low coercive force and residual magnetic flux densities suitable as a convergence yoke used as an object for tee sprays in more detail about a soft magnetism sintered alloy with low coercive force and residual magnetic flux density, and a manufacturing method for the same.
[0002]
[Description of the Prior Art]In order to improve a high frequency characteristic conventionally, the method of adding and sintering [fabricate and] insulating high molecular compounds, such as an epoxy resin, is used for the powder of iron or nickel. However, since a strain would arise to the powder of iron or nickel with the pressure which takes at the time of shaping and this strain would not be recovered with the curing temperature (150-200 **) of an epoxy resin if it does in this way and a sintered alloy is manufactured, degradation of the characteristic had been caused as a soft magnetism sintered alloy.
[0003]By adding the high nonmetal of the electric insulation of water glass etc. to the powder of iron or nickel, and covering this on the surface of the powder of iron or nickel, in order to improve this, As compared with the case where become possible to remove by annealing and this is not covered even if a strain arises to the powder of iron or nickel with the pressure which takes at the time of shaping, the high frequency characteristic of a soft magnetism sintered alloy can be raised now.
[0004]However, when water glass is used for covering material, with not less than 600 **, since heat resistance is high enough, can anneal it at a high temperature, and can abolish mostly the strain of the powder of iron or nickel by which it is generated at the time of shaping, but. SUBJECT that it was difficult to form the enveloping layer of uniform thickness, and it tends to produce dispersion in the characteristic also occurred.
[0005]
[Problem to be solved by the invention]This invention solves an aforementioned problem, is easy to manufacture, and moreover has the frequency characteristic of amplitude permeability also with high high frequency, and aims at offer of the convergence yoke using a soft magnetism sintered alloy low [both] and a manufacturing method for the same, and this soft magnetism sintered alloy of coercive force and a residual magnetic flux density.
[0006]
[Means for solving problem]The soft magnetism sintered alloy with both low coercive force and residual magnetic flux densities of this invention has an oxide of metal with bigger oxygen affinity than iron nickel in the particle surface of the soft magnetism sintered alloy which consists of 30% or less of copper 0% or more mainly by iron and/or nickel, and a weight ratio.
[0007]Copper is used here in the form for which nickel is substituted, and although it is not necessarily a required element, when a proper quantity is used, it has an effect which improves a moldability. As a copper content ratio, it is preferred that it is 10 to 25%.
[0008]As metal with bigger oxygen affinity than iron, aluminum, titanium, silicon, a zirconium, magnesium, chromium, beryllium, calcium, cerium, boron, vanadium,

niobium, manganese, etc. are mentioned, for example. Among these, especially desirable things are aluminum, titanium, silicon, a zirconium, magnesium, chromium, etc. these -- one sort -- or two or more sorts can be used. Although using in a metaled form is preferred, it may be a compound which turns into an oxide easily. Since oxygen affinity of iron is larger than nickel and copper, it can be said that metal with bigger oxygen affinity than iron is metal with bigger oxygen affinity than nickel and copper.
[0009]A desirable content ratio of these metal sets 30% or less of copper to 100 0% or more by iron and/or nickel, and a weight ratio, respectively, and by a weight ratio 0.01 to 5% of aluminum, 0.01 to 5% of titanium, 0.1 to 10% of silicon, 0.01 to 3% of a zirconium, They are 0.01 to 3% of magnesium, 0.1 to 20% of chromium, 0.01 to 3% of beryllium, 0.01 to 3% of calcium, 0.01 to 3% of cerium, 0.01 to 3% of boron, 0.1 to 10% of vanadium, 0.1 to 10% of niobium, and 0.1 to 10% of manganese. Among these, although it is especially desirable, desirable content ratios are 0.02 to 1.0% of aluminum, 0.1 to 2.0% of titanium, 0.5 to 4.0% of silicon, 0.01 to 0.5% of a zirconium, 0.02 to 0.5% of magnesium, and 3.0 to 15.0% of chromium, respectively.
[0010]In not forming the enveloping layer of sufficient thickness when less than these desirable ranges, and exceeding these desirable ranges conversely, The oxide of metal with bigger oxygen affinity than iron may exist in the inside of the end of precursor powder, and the becoming after alloy powder, and there is a possibility that all may cause the fall of magnetic properties.
[0011]Thus, the soft magnetism sintered alloy obtained is suitable for the convergence yoke which has the frequency characteristic of amplitude permeability also with high high frequency, and is used for a display since both coercive force and the residual magnetic flux density are low.
[0012]The manufacturing method of a soft magnetism sintered alloy with both low coercive force and residual magnetic flux densities of this invention, The after alloy powder which consists of 30% or less of copper and metal with bigger oxygen affinity than iron 0% or more mainly by iron and/or nickel, and a weight ratio is heated in an oxidizing atmosphere, and it fabricates to prescribed shape after that, and sinters.
[0013]About copper and metal with bigger oxygen affinity than iron, it is the same as that of the above-mentioned. Although the particle diameter in particular of the after alloy powder to be used is not restricted, when a moldability will become good if particle diameter becomes large, and it becomes small, there is a tendency for a degree of sintering to become good. The range desirable as particle diameter is 20-150 micrometers.
[0014]Iron before considering it as an alloy here, nickel, copper, and metal with bigger oxygen affinity than iron do not ask a form in particular. That is, it does not matter whether it is powder or is ingot material like an ingot. Even if it is not necessary to be a simple substance and is the oxide, it is satisfactory in any way.
[0015]Then, although this after alloy powder is heated in an oxidizing atmosphere, it is important in this case to consider it as an alloy with iron and/or nickel using metal with bigger oxygen affinity than iron.
[0016]That is, since it is considered as after alloy powder with metal with bigger oxygen affinity than iron, and/or nickel and iron, metal with bigger oxygen affinity than iron in after alloy powder moves to the after-alloy-powder surface by heating in an oxidizing atmosphere. And it reacts to oxygen in atmosphere in the surface of after alloy powder,

and an oxide is generated.
[0017]Under the present circumstances, iron and nickel hardly receive oxidation according to atmosphere. This is for a direction of this metal to receive oxidation selectively, when metal with bigger oxygen affinity than iron exists in an alloy and oxidation works.
[0018]As a result, it exists without iron and/or nickel, and copper almost oxidizing near a center with heating, as for after alloy powder, and an oxide of metal with bigger oxygen affinity than iron was covered by that powder surface, and it comes and exists in it.
[0019]In order not to make for this oxidizing atmosphere to oxidize iron and/or nickel, and copper into the purpose, the atmosphere to which oxidation advances to urgency is not so preferred, for example, it is made to heat at 600-1000 ** in hydrogen gas containing a steam for 1 to 5 hours.
[0020]Thus, the soft magnetism sintered alloy of this invention can be obtained by making into the end of precursor powder the powder which covered the metallic oxide on the surface of iron and/or nickel, and copper, and performing predetermined and a publicly known molding method, and a sintering process. Powder lubricant can also be used when fabricating. As powder lubricant, a stearic acid system, an acid wax system, etc. are mentioned, zinc stearate is mentioned as a stearic acid system, and for example, ethylenebis AKOIDO is mentioned as an acid wax system.
[0021]As a process condition, press forming of 500 - 700MPa, etc. are preferred. As a sintering condition, the method of sintering at 800-1100 ** among hydrogen for 0.5 to 3 hours is preferred.
[0022]It is good also as the end of precursor powder to cover the water glass further used for the powder which covered the metallic oxide on the surface of iron and/or nickel, and copper conventionally. in this case, unlike covering of the oxide to the surface of metal in the case of covering water glass directly on the surface of the powder which consists of iron and/or nickel, and copper, since it is covering of the oxide to an oxide surface, a wettability is markedly easy to be alike, and the enveloping layer of water glass of almost uniform thickness is obtained.
[0023]
[Function]The soft magnetism sintered alloy of this invention became possible [having the frequency characteristic of amplitude permeability also with high high frequency, and both making low coercive force and a residual magnetic flux density] by having had the above-mentioned composition. By using this soft magnetism sintered alloy, it became possible to use suitably for the convergence yoke used for a display.
[0024]Metal with bigger oxygen affinity than 30% or less of copper and iron is used as after alloy powder 0% or more by iron and/or nickel, and a weight ratio, Since the enveloping layer of the metallic oxide used as an electrical insulation layer can be formed in the surface of the powder of 0% or more 30% or less of copper by iron and/or nickel, and a weight ratio only by making it oxidize, It is not necessary to make a conventional epoxy resin and water glass cover on the surface of powder, and the enveloping layer of moreover almost uniform thickness can form now easily.
[0025]
[Working example]Next, this invention is more concretely explained with reference to the following embodiments.
- Atomization processing was carried out and it was considered as atomization powder

with a mean particle diameter of 70 micrometers at the molten metal which consists of 10 weight % of embodiment 1 iron, 70 weight % of nickel, 20 weight % of copper, and 0.2 weight % of aluminum.
[0026]It oxidized on 800 ** and the conditions of 3 hours among the hydrogen gas (wet hydrogen gas) atmosphere which let underwater pass to this after alloy powder. As a result, it formed so that an aluminum oxide might cover particles on the powder surface.
[0027]Thus, the aluminum oxide made after alloy powder which consists of iron, nickel, and copper which were covered on the surface the end of precursor powder, added 1 weight % of amide wax as powder lubricant to this, carried out press forming by 600MPa, and fabricated a 40x30x5-mm Plastic solid. This Plastic solid was sintered on the hydrogen gas atmosphere of 900 **, and the conditions of 2 hours, and the soft magnetism sintered alloy was obtained.
- Atomization processing was carried out and it was considered as atomization powder with a mean particle diameter of 70 micrometers at the molten metal which consists of 10 weight % of embodiment 2 iron, 70 weight % of nickel, 20 weight % of copper, and 0.5 weight % of titanium.
[0028]It oxidized on 800 ** and the conditions of 3 hours among the hydrogen gas (wet hydrogen gas) atmosphere which let underwater pass to this after alloy powder. As a result, it formed so that titanium oxide might cover particles on the powder surface.
[0029]Thus, titanium oxide made after alloy powder which consists of iron, nickel, and copper which were covered on the surface the end of precursor powder, added 1 weight % of amide wax as powder lubricant to this, carried out press forming by 600MPa, and fabricated a 40x30x5-mm Plastic solid. This Plastic solid was sintered on the hydrogen gas atmosphere of 900 **, and the conditions of 2 hours, and the soft magnetism sintered alloy was obtained.
- Atomization processing was carried out and it was considered as atomization powder with a mean particle diameter of 70 micrometers at the molten metal which consists of 10 weight % of embodiment 3 iron, 70 weight % of nickel, 20 weight % of copper, and 0.03 weight % of magnesium.
[0030]It oxidized on 800 ** and the conditions of 3 hours among the hydrogen gas (wet hydrogen gas) atmosphere which let underwater pass to this after alloy powder. As a result, it formed so that magnesium oxide might cover particles on the powder surface.
[0031]Thus, magnesium oxide made after alloy powder which consists of iron, nickel, and copper which were covered on the surface the end of precursor powder, added 1 weight % of amide wax as powder lubricant to this, carried out press forming by 600MPa, and fabricated a 40x30x5-mm Plastic solid. This Plastic solid was sintered on the hydrogen gas atmosphere of 900 **, and the conditions of 2 hours, and the soft magnetism sintered alloy was obtained.
- Atomization processing was carried out and it was considered as atomization powder with a mean particle diameter of 70 micrometers at the molten metal which consists of 53 weight % of embodiment 4 iron, 47 weight % of nickel, and 11 weight % of chromium.
[0032]It oxidized on 800 ** and the conditions of 3 hours among the hydrogen gas (wet hydrogen gas) atmosphere which let underwater pass to this after alloy powder. As a result, it formed so that magnesium oxide might cover particles on the powder surface.
[0033]Thus, chrome oxide made the iron covered on the surface, and after alloy powder which consists of nickel the end of precursor powder, added 1 weight % of amide wax as

powder lubricant to this, carried out press forming by 600MPa, and fabricated a 40x30x5-mm Plastic solid. This Plastic solid was sintered on the hydrogen gas atmosphere of 900 **, and the conditions of 2 hours, and the soft magnetism sintered alloy was obtained.
- Atomization processing was carried out and it was considered as atomization powder with a mean particle diameter of 70 micrometers at the molten metal which consists of 10 weight % of embodiment 5 iron, 70 weight % of nickel, 20 weight % of copper, and 0.2 weight % of aluminum.
[0034]It oxidized on 800 ** and the conditions of 3 hours among the hydrogen gas (wet hydrogen gas) atmosphere which let underwater pass to this after alloy powder. As a result, it formed so that an aluminum oxide might cover particles on the powder surface.
[0035]Thus, after alloy powder which consists of iron, nickel, and copper which the aluminum oxide covered on the surface is made into the end of precursor powder, After adding 2 weight % of water glass to this and forming an enveloping layer in it on the surface of after alloy powder, 1 weight % of amide wax was added as powder lubricant, press forming was carried out by 600MPa, and a 40x30x5-mm Plastic solid was fabricated. This Plastic solid was sintered on the hydrogen gas atmosphere of 900 **, and the conditions of 2 hours, and the soft magnetism sintered alloy was obtained.
- Atomization processing was carried out and it was considered as atomization powder with a mean particle diameter of 70 micrometers at the molten metal which consists of 10 weight % of comparative example 1 iron, 70 weight % of nickel, and 20 weight % of copper.
[0036]After adding 2 weight % of epoxy resins to this after alloy powder and forming an enveloping layer on the surface of after alloy powder, 1 weight % of amide wax was added as powder lubricant, it mixed, press forming was carried out by 600MPa, and a 40x30x5-mm Plastic solid was fabricated. This Plastic solid was sintered on 200 ** and the conditions of 1 hour among the atmosphere, and the soft magnetism sintered alloy was obtained.
- Atomization processing was carried out and it was considered as atomization powder with a mean particle diameter of 70 micrometers at the molten metal which consists of 10 weight % of comparative example 2 iron, 70 weight % of nickel, and 20 weight % of copper.
[0037]After adding 2 weight % of water glass to this after alloy powder and forming an enveloping layer on the surface of after alloy powder, 1 weight % of amide wax was added as powder lubricant, it mixed, press forming was carried out by 600MPa, and a 40x30x5-mm Plastic solid was fabricated. This Plastic solid was sintered on 900 ** and the conditions of 1 hour among hydrogen, and the soft magnetism sintered alloy was obtained.
- Atomization processing was carried out and it was considered as atomization powder with a mean particle diameter of 70 micrometers at the molten metal which consists of 10 weight % of comparative example 3 iron, 70 weight % of nickel, and 20 weight % of copper.
[0038]1 weight % of amide wax was added as powder lubricant to this after alloy powder, it mixed to it, press forming was carried out by 600MPa, and a 40x30x5-mm Plastic solid was fabricated. This Plastic solid was sintered on 900 ** and the conditions of 1 hour among the atmosphere, and the soft magnetism sintered alloy was obtained.
[0039]The frequency characteristic, the coercive force, and the residual magnetic flux

density of amplitude permeability of the soft magnetism sintered alloy obtained by the embodiment and the comparative example were measured. the ratio of the initial permeability in 100 kHz when the frequency characteristic of amplitude permeability is based on the initial permeability at the time of 1 kHz here -- % -- a table -- the bottom is a thing (1 kHz) (%), i.e., mu_{iac}(100 kHz)/mu_{iac}. Both coercive force and a residual magnetic flux density measure coercive force and a residual magnetic flux density in case deltaB is 0.1T. This result is shown in Table 1.

[0040]

[Table 1]

	透磁率の周波数特性	保磁力（A／m）	残留磁束密度（T）
実施例 1	99	62	0.005
実施例 2	98	69	0.005
実施例 3	98	64	0.005
実施例 4	97	77	0.005
実施例 5	99	58	0.005
比較例 1	94	121	0.01
比較例 2	92	60	0.01
比較例 3	27	51	0.03

[0041]Compared with a case where a conventional epoxy resin and water glass are covered on the surface of direct after alloy powder, it has the frequency characteristic of high amplitude permeability, and a soft magnetism sintered alloy with both low coercive force and residual magnetic flux densities was obtained so that clearly also from Table 1.

[0042]

[Effect of the Invention]As explained above, according to this invention, it has the frequency characteristic of amplitude permeability also with high high frequency, and a soft magnetism sintered alloy with both low coercive force and residual magnetic flux densities is obtained. This soft magnetism sintered alloy is suitable for the convergence yoke used for a display.

[0043]Since the enveloping layer of the metallic oxide used as an electrical insulation layer can be formed in the surface of the powder of 0% or more 30% or less of copper by iron and/or nickel, and a weight ratio only by mixing metal powder to the powder of 30% or less of copper 0% or more by iron and/or nickel, and a weight ratio, It is not necessary to make a conventional epoxy resin and water glass cover on the surface of powder, and the enveloping layer of moreover almost uniform thickness can be formed easily.

CLAIMS

[Claim(s)]

[Claim 1]A soft magnetism sintered alloy on the sintered particle surface of a soft magnetism sintered alloy which consists of 30% or less of copper 0% or more mainly by

iron and/or nickel, and a weight ratio in which both coercive force and residual magnetic flux densities having an oxide of big metal of oxygen affinity are lower than iron.
[Claim 2]A convergence yoke which becomes the sintered particle surface of a soft magnetism sintered alloy which consists of 30% or less of copper 0% or more mainly by iron and/or nickel, and a weight ratio from a soft magnetism sintered alloy in which both coercive force and residual magnetic flux densities having an oxide of big metal of oxygen affinity are lower than iron.
[Claim 3]Mainly by iron and/or nickel, and a weight ratio, 0% or more 30% or less of copper, A manufacturing method of a soft magnetism sintered alloy in which both coercive force and residual magnetic flux densities that heat after alloy powder which consists of big metal of oxygen affinity in an oxidizing atmosphere, fabricate to prescribed shape after that, and are characterized by sintering are lower than iron.